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U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
A. C. TRUE, Director.

ORGANIZATION AND WORK OF THE OFFICE OF EXPERIMENT STATIONS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

P. H. Ross, Assistant at Kenai.
C. W. H. Heideman, Assistant at Copper Center.

HAWAII EXPERIMENT STATION.

Jared G. Smith, B. S., M. A., Special agent in charge, Honolulu.
D. L. Van Dine, B. S. A., Entomologist.
J. E. Higgins, B. A., M. S. A., Expert in horticulture.
F. G. Krauss, Rice expert.
C. R. Blacow, in charge of tobacco experiments.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., April 1, 1907.

SIR: I have the honor to transmit herewith and recommend for publication a brief general account of the organization and work of the Office of Experiment Stations. This article has been prepared for distribution at the Jamestown Ter-Centennial Exposition.

Respectfully,

A. C. TRUE,
Director.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ORGANIZATION AND WORK OF THE OFFICE OF EXPERIMENT STATIONS.

RELATIONS OF THE OFFICE WITH THE EXPERIMENT STATIONS.

The agricultural experiment stations in the United States are State institutions supported in part by funds given by the Federal Government to the States to be used for their maintenance. The direct management of the stations is wholly in the hands of State officers. The appropriations, however, called for by the Hatch Act are made by Congress from year to year and come under the head of annual appropriations for the Department of Agriculture.

With the passage of the Hatch Act providing funds for the support of agricultural experiment stations in the various States and Territories in 1887, it became necessary to maintain an office in the Department of Agriculture entrusted with the general supervision of the work and expenditures of these stations. Accordingly the Office of Experiment Stations was established in 1888 to represent the Secretary of Agriculture in his relations with the stations. This work of supervision is, therefore, the main organic function of the Office and still remains its chief duty, although a number of other lines of work have been assigned to it.

The Office maintains very intimate relations with the stations in the several States and Territories, with the result that all of them are thereby bound together into a national system. The functions of the Office in this regard are partly supervisory and partly advisory. An annual inspection of the stations is made for the purpose of examining into their work and their expenditures under the Federal funds and for inquiring into the relations and management of the stations as well as their general efficiency.

POLICY OF INSPECTION.

The inspection of the operations of the experiment stations is of a broader character than the term would imply. It is not confined to an examination of the accounts and financial reports, but extends to all the activities of the stations and their relations to other agricultural agencies. The determination of the legality of the expenditures involves a consideration of the whole work of the stations, their efficiency, relations, and general influence. No fixed rules can be established as to the amounts of money which may be legally expended for certain apparatus, salaries for certain purposes, administration, heat, light, or other purposes. These matters must be determined independently in each case after a consideration of the demands made upon the station and the facilities which it possesses for its work.

In this annual inspection the relations of the stations to the colleges of agriculture also receive attention, particularly the matter of the division of salaries of station officials who are also teachers in the colleges, and the purchase of equipment which is used jointly by the stations

and colleges. In this inspection many problems are presented which could not be solved by an appeal to the terms of the law, but are adjusted rather by an appeal to good policy and the various interests involved. In this work a broad view of the functions of the stations has been taken, and in general the effort has been made to defend their interests and upbuild their work without in any way destroying their autonomy.

The phraseology of the Hatch Act is so broad that without a close construction the funds might be expended for too great a variety of work without accomplishing the true purpose for which they were appropriated. The attempt has been made, therefore, to bring it about that as far as the Federal appropriations are concerned they shall be restricted quite closely to expenses directly connected with experimental work and the dissemination of the results thus obtained.

The inspection of the agricultural experiment stations carried on by the Office is not confined to a brief annual visit, but is going on in one way or another throughout the year. There is a continual correspondence with the stations upon the matters of policy, progress of the work, the use of funds, etc.

The Office passes upon and approves their annual financial reports, which are made in accordance with the schedules prescribed by the Secretary of Agriculture, and on the basis of which the payments by the Treasury Department are made. Under the Adams Act, passed in 1906, the supervision of work and expenditures goes somewhat further, for the Department is charged with the administration of the law as a whole.

The advisory relations with the stations have to do largely with their general policy, organization, relations

to teaching, and other lines of work, personnel, etc. From its wide acquaintance with agricultural experts and with the needs of the stations, the Office is able to assist in recruiting their working forces, and maintains a register of available men for that purpose. Furthermore, the Office points out the needs of the stations in buildings and equipment, urges the importance of arrangements which will insure time and liberty to station officials for their legitimate work, arranges for cooperation and assistance, and advocates their cause generally. Its whole effort is directed toward furthering and strengthening the stations and their work by conserving their funds, protecting their interests, stimulating their activities along lines of thorough work, and maintaining a central agency for the experiment stations and for exploiting their work.

RESULTS OF INSPECTION

The result of this inspection and the attitude taken by the Office toward experiment station work is seen in the prevention of the dissipation of Federal funds and in the steady development of the stations in efficiency, quality of work, and concentration of effort. Its functions in this respect have been increased in importance by the passage of the Adams Act in 1906, the administration of which has been placed in charge of the Office by the Secretary of Agriculture. The work of the stations under the Adams Act is strictly confined to original research in agricultural lines. By its interpretation of this act and the regulations regarding the expenditures of the Adams fund this Office is endeavoring to aid the stations in inaugurating a much larger amount of the more scientific and fundamental researches through which it is hoped to establish principles of wide reaching and perma-

nent value to the agriculture of the United States. In this way, also, it is believed that a broad and firm scientific basis will be laid for the more practical work of the stations, and for the instruction in agricultural science and practice given in our agricultural colleges and schools, as well as through farmers' institutes, agricultural organizations, and the agricultural books and journals.

EXPERIMENT STATIONS IN ALASKA, HAWAII, AND PORTO RICO.

No provision was made in the Hatch Act for the establishment of experiment stations in Alaska nor in the later acquired Territories of Hawaii and Porto Rico. As the need was felt for agricultural investigations in these Territories, appropriations were made in the funds of the Office of Experiment Stations for the establishment and maintenance of experiment stations in Alaska in 1897, and in Hawaii and Porto Rico in 1901. The Office sustains a different relation with these stations than with the stations established under the Hatch Act. The latter are partly supported by State funds and are under the control of a local governing board which appoints all officers and transacts all necessary business, subject only to the supervision of the Office, as explained on page 8. In the case of the stations in Alaska, Hawaii, and Porto Rico, on the other hand, all appointments are made by the Secretary of Agriculture through the Office, and the officials are therefore on the roll of the Office. There is no local governing board, and the supervision of the funds and the determination of the policy of the stations originates from the Office under authority from the Secretary.

ALASKA.

The policy of the Office in directing the work of these insular stations has been the general one of improving agricultural practice in these Territories and making such investigations as were necessary to develop the agricultural resources and possibilities of the Territories. In Alaska, previous to the establishment of the station, it was even doubted whether the Territory was in any way suited to agricultural practices. It was necessary, therefore, to carry on experiments which would show whether the common field and garden crops and domestic animals could be successfully grown in various parts of the Territory.

The central station is located at Sitka, with branches at Kenai, Copper Center, Rampart, and Fairbanks. The horticultural work in Alaska has been chiefly carried on at Sitka and is concerned with investigations of the soil requirements and cropping seasons of garden vegetables, potatoes, small cultivated fruits, and various wild fruits. A number of wild fruits of unusual promise are being tested and some work in hybridization has been done to determine the possibility in the improvement of these wild species. In the interior of the Territory, particularly at the Copper Center and Rampart stations, much attention has been given to cultural experiments with cereals, hay, and forage crops. A number of varieties of wheat, oats, barley, and rye have been found which thrive excellently under the peculiar climatic conditions of the Territory.

Recently attention has been turned to the improvement of live stock. At Kenai a herd of Galloway cattle was established in 1906 which was considerably increased in 1907. The purpose of this experiment is to determine the

adaptability of Galloways to the climate of Alaska and their suitability for use in grading up the native cattle. An attempt will be made in breeding Galloways at Kenai to produce an even longer and more curly coat than they normally possess, in order to make it of still greater value for rugs and robes. It is also hoped that the milking quality of the Galloway may be improved under proper selection. Heretofore little attention has been given to horses in Alaska on account of the great expense of keeping them over winter. This problem of winter maintenance is being investigated.

HAWAII.

In Hawaii the station is making a study of tropical agriculture, including all of the more important commercial plants of the Tropics with the exception of sugar cane, which is already provided for by the Sugar Planters' Station of Hawaii. Particular attention has been given to tobacco, coffee, rubber, rice, forage plants, bananas, citrus fruits, grapes (of which about three hundred varieties are being tested), mangoes, avocados, papayas, pineapples, and sisal. The tobacco work is being carried on in the Hamakua district. It appears that a most excellent quality of tobacco can be produced there and the commercial development of the tobacco district is likely to follow upon these investigations.

One of the difficulties in the way of the extensive development of tropical agriculture in Hawaii has been that of securing markets and proper transportation. These problems are being studied by the station, and a number of experimental shipments of various products have been made, particularly to San Francisco, Portland, and Seattle.

In the line of forestry, experiments have been carried on

to determine the value and importance of the black wattle in the production of bark for commercial purposes and reforestation of denuded and other areas with eucalyptus and other trees.

PORTO RICO.

In Porto Rico the main station is located at Mayaguez, with a branch coffee station at La Carmelita. In general, the line of work carried on in Porto Rico is similar to that in Hawaii. Rubber is relatively less important and experiments with rice have just been begun. About one hundred varieties of citrus fruits are under observation. There are a number of seedling oranges, two of which are of the navel type, and very excellent. Much attention has been given to pineapples, of which 25 varieties are being grown. During the past two years experimental shipments have been made to New York to determine their shipping qualities and their attractiveness in competition with other varieties of pineapples.

It has been found that, contrary to the commonly accepted notion, a number of the northern garden crops may be successfully grown in Porto Rico. The station cooperates with sugar planters in the use of fertilizers and in breeding work. About thirty varieties of coffee are being tested and some new varieties have been established. This work is being carried on very energetically, and a system of coffee nurseries has been established and is being adopted by coffee planters in the island.

The work with fiber plants is largely confined to a study of sisal and maguey. Attention is also being given to methods of covering bald hills with forest growth in order to prevent erosion.

One of the chief lines of work of the station is that of animal breeding. The native animals of the island are

of poor type, and there is abundant opportunity for improvement in all directions. An attempt is being made, therefore, to introduce better blood in horses, cattle, hogs, chickens, ducks, and geese. This work involves a careful study of acclimatization, in order to prevent a loss of vigor in imported pure-bred animals and the appearance of tropical diseases among them.

AGRICULTURAL EDUCATION.

The Office is the general agency of the Department of Agriculture for the promotion of agricultural education in the United States. At the meetings of the Association of American Agricultural Colleges and Experiment Stations the Director of the Office represents the Department and is a member of the standing committee on instruction in agriculture. This committee has given much study to the formulation of agricultural courses, and has submitted a number of reports outlining such courses for agricultural colleges and secondary and elementary schools. The Director of the Office is also dean of the Graduate School of Agriculture, which considers methods of instruction.

For several years the Office has kept a record of progress in agricultural education in this country and abroad by means of a study of published curricula of instruction and other literature and also by visits to the various educational institutions. Statistics and organization lists of the agricultural colleges are annually compiled and published, as are also special bulletins on different phases of agricultural education. Members of the Office staff attend and give addresses at important gatherings of agricultural educators in all parts of the country. The general

field of agricultural education, as covered by the Office, is now divided for practical purposes into (1) the educational work of agricultural colleges and schools, and (2) farmers' institutes and other forms of itinerant extension work in agriculture.

In its relations with agricultural colleges and schools the Office follows and records the progress of agricultural education in this and foreign countries through abstracts of important literature in the Experiment Station Record and by the publication of statistics and special articles relating to the subject. A card index is kept of agricultural institutions, and lists of American institutions teaching agriculture are published from time to time. The Office gives assistance to agricultural colleges and other schools which teach agriculture in the preparation of agricultural courses and in suggestions regarding effective methods of teaching agricultural science. This work is chiefly accomplished by cooperation with the Association of American Agricultural Colleges and Experiment Stations. Much help is also rendered the agricultural organizations of the several States in promoting agricultural education in rural high schools, consolidated common schools, and other schools. The cause of agricultural education is furthered by assisting agricultural colleges and normal schools in inaugurating training courses for teachers of agriculture and by assisting these teachers to secure suitable literature and other material for their work. The Office is making a special effort to increase the efficiency of agricultural instruction in the negro land-grant colleges, in order that the funds granted for negro education by the Federal Government may contribute toward making the negro a more efficient factor in agricultural production.

An increasing demand is made upon the Office for assistance in outlining courses of study in agriculture; in procuring suitable instructors in agriculture for summer schools and teachers' institutes; in the selection of teachers, text-books, and laboratory material for agricultural schools and agricultural work in public schools; and in securing instructors and heads of departments in agricultural colleges.

FARMERS' INSTITUTES.

The rapid development of farmers' institutes in this country and the appreciation of their importance in agricultural extension work is apparent from the fact that in 1906 3,365 institutes were held, at which there was a total attendance of 1,262,272. In addition to these regular institutes, a large number of round-up meetings are held in various States and also special institutes, some of which were conducted by means of special trains which traveled about from place to place. As the value of this method of instruction became assured and its popularity was recognized, it attracted the attention of the Federal Government, and the Fifty-seventh Congress made an appropriation of $5,000 for meeting the necessary expenses and paying the salary of a farmers' institute specialist assigned to the Office of Experiment Stations.

The duties of this officer, as stated in the act making the appropriation, are "to investigate and report upon the organization and progress of farmers' institutes in the several States and Territories and upon similar organizations in foreign countries, with special suggestions of plans and methods for making such organizations more effective for the dissemination of the results of the work

of the Department of Agriculture and the experiment stations and of improved methods of agricultural practice." The Farmers' Institute Specialist was appointed and this work began in 1903.

The farmers' institute work of the Office consists in an investigation of the organization of methods for this means of agricultural extension; in publishing bulletins of information; collecting and publishing laws under which institutes are held in the several States and Territories; and securing lists of names of State directors, institute lecturers, and local managers of farmers' institutes.

Much of the work of farmers' institutes has been confined to stimulating a desire for agricultural education and improvement in farm methods. The Office has assisted in creating a demand for more specific instruction to be given at the institute meetings. The Office has met this need and demand for greater efficiency in institute work by having prepared courses of study adapted to mature pupils and to be given in "movable schools of agriculture." Courses on cheese making and fruit growing have been prepared and others are under consideration. Each course is intended to occupy from ten to fifteen days in its presentation, the students in each class to number not less than 8 nor more than 15, to be over 18 years of age, and to have had at least one year's previous practical experience in the subject which the course covers. The schedule for each day consists in a lecture occupying one hour, after which the student is supplied with a syllabus containing reference to authorities upon the subject. The students are then required to consult the references, after which they are called upon to perform the various operations outlined in the lecture. The various bulletins, circulars, separates, and illustrated lectures relating

to farmers' institutes, published by the Office, may be learned by obtaining the classified list of the Office publications.

The Office works in cooperation with the American Association of Farmers' Institute Workers, which was organized in 1896, and publishes the reports of the proceedings of its meetings.

In addition to the assistance which it gives to the American Association of Farmers' Institute Workers, the Office is cooperating with the Association of American Agricultural Colleges and Experiment Stations. The Farmers' Institute Specialist is secretary of the standing committee of the association, which was created for conducting investigations of methods by which the agricultural colleges can extend their work of giving instruction in agriculture to residents of rural communities who are unable to attend an agricultural college.

PUBLICATIONS.

On the basis of its relations with the stations and of their publications the Office is required by law to make an annual report to Congress upon the progress of the stations, their work, general efficiency, usefulness, and similar matters. The compilation of agricultural information is in a special sense a leading function of the Office. A large number of technical and popular publications are prepared on a great variety of agricultural subjects. In addition to reporting the results of its own investigations on food and nutrition of man, irrigation and drainage, and the various lines of work carried on under its direction in the agricultural experiment stations of Alaska, Hawaii, and Porto Rico, the Office collects,

digests, and disseminates information regarding the progress of agricultural research and education in the United States and other countries.

EXPERIMENT STATION RECORD.

The leading publication of the Office is the Experiment Station Record, a periodical (twelve numbers and an index yearly) which gives a technical review of the current literature of agricultural investigation, not only in the United States but throughout the world. The literature reviewed in this periodical includes not only books and annual reports relating to agriculture, but also about 1,600 periodicals in twelve or more languages. In a sense supplementing the Record, Experiment Station Work is published every two months in the series of Farmers' Bulletins of the Department, and gives popular summaries in a series of short articles of the more important practical results of agricultural investigation, particularly in the experiment stations of this country.

NUTRITION PUBLICATIONS.

The food and nutrition publications of the Office include a large number of technical and popular bulletins, circulars, and miscellaneous documents reporting or based upon the nutrition investigations of the Office and dealing with the cost, composition, and functions of food and food nutrients; the effect of milling, cooking, and other methods of treatment on the nutritive value of foods; and dietary studies and other investigations intended to promote the best utilization of agricultural food products by people belonging to various classes. Several bulletins of a technical character have been published regarding the metabolism of foods in the human body.

IRRIGATION AND DRAINAGE PUBLICATIONS.

The publications of the Office on irrigation and drainage investigations relate mainly to irrigation laws and institutions the development and status of irrigation in humid as well as in arid regions, the water requirements of crops, and the duty of water in irrigation, methods of applying water, drainage of seeped and swamped lands, pumping water for irrigation, and other uses of power for farm purposes and farm machinery. The publications of the Office on irrigation practice in the far West cover nearly all of the ordinary farm, garden, and food crops, while in the humid parts of the country attention has been given chiefly to market and garden crops, rice, cranberries, etc.

MISCELLANEOUS PUBLICATIONS.

The Office has issued a series of publications dealing with different phases of agricultural education, such as the organization of courses of instruction in agricultural colleges and secondary and elementary schools, farmers' institutes, and other forms of extension teaching in agriculture, movable or itinerant schools of agriculture, farmers' institute lectures, progress of agricultural education in various lines in this country and abroad, and related topics. Some of the miscellaneous publications of the Office, including the proceedings of the Association of American Agricultural Colleges and Experiment Stations and the American Association of Farmers' Institute Workers, are also of interest largely in connection with the subject of agricultural education.

ANNUAL REPORTS

Two annual reports are issued by the Office, of which the report of the Director is a brief account of the work of the Office each year, while the other or annual report of the Office is a larger document, in which administrative details are reduced to a minimum, and an attempt is made to show the progress of agricultural research and education in the United States during the period covered by the report. This is accomplished by means of a detailed report on the work of the Office and of the several agricultural experiment stations and by articles illustrating the progress in nutrition, irrigation, and drainage investigations, farmers' institutes and agricultural education, and in various special lines of investigation at the experiment stations.

CARD INDEX AND LISTS OF PUBLICATIONS.

Among the other important publications of the Office are a card index of experiment station literature issued in a limited edition and of value mainly to investigators, and a monthly list of the current issue of experiment station publications, of interest chiefly to libraries and those specially interested in following the publications of the experiment stations in the United States.

Detailed and classified lists of the Office publications, explaining their nature and how they may be obtained, may be had on application to the Director of the Office.

NUTRITION INVESTIGATIONS.

The nutrition investigations of the Office were begun in 1894 on a cooperative basis. In this work the Office has been associated with agricultural colleges, experi-

ment stations, universities, and other educational or philanthropic institutions. The cooperative work has been done in 19 States and 3 Territories.

The chief object of the nutrition investigations has been to learn the nutritive value of agricultural products of animal and vegetable origin and the proportions in which such materials may best be used as human food. The work has, in the main, consisted of dietary studies, digestion experiments, studies of the metabolism of matter and energy, changes brought about in meat, legumes, flour, and other food products by cooking, and also investigations of experimental methods and the construction of apparatus used in nutrition work.

The various problems to be studied have been assigned to institutions which were best fitted for carrying on the particular kind of work. Thus in California, the nutritive value of fruits and nuts has been studied. In Connecticut, investigations have been made on the relative values of fats and carbohydrates in the diet, and other questions relating to the fundamental laws of nutrition. In this connection, the respiration calorimeter, devised by the nutrition experts, has rendered signal service. In Maine and Minnesota, studies have been made on the nutritive value of flour, cereal breakfast foods, and other cereal products, while in Illinois investigations are carried on regarding the nutritive value of meat, the changes due to cooking by different methods, and its digestibility under different conditions. In Tennessee, the digestibility and nutritive value of various legumes have been studied.

The results of these investigations have been published in about 55 technical bulletins, 35 farmers' bulletins, and other popular articles. The nutrition investigations have rendered available a large amount of statistical data

regarding the composition and nutritive value of foods, the digestibility, and the kind and amount of nutritive material required by individuals living under different conditions. As a basis for the formulation of dietaries, the place of fruits and nuts in the diet has been indicated, and the relative nutritive values and physiological effects of graham, whole wheat, and standard patent flours have been determined. By means of comparative experiments the relative losses of different nutritive constituents in cooking meat in different ways have been accurately determined. In this work it was also found that the factors which control the flavor and appearance of cooked meat are readily controllable.

Recently experiments have been undertaken at Wesleyan University, Connecticut, to determine the digestibility and nutritive value of American cheddar cheese made with different proportions of rennet and cured for different lengths of time. In these experiments cheese was readily digested and was eaten at the rate of one-half pound per day without causing digestive disturbances of any sort.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

The study of the problems of irrigation and drainage was begun by the Office in 1899 under an appropriation by Congress "for the purpose of collecting from agricultural colleges, agricultural experiment stations, and other sources, including the employment of practical agents, valuable information and data on the subject of irrigation and publishing the same in bulletin form." This work, as first organized, was in two general lines, the collection and publication of information regarding the laws

and institutions of the irrigated region in their relation to agriculture and the publication of available information regarding the use of water in agriculture as determined by the experience of farmers and experimental investigators. From the start the irrigation and drainage work of the Office has been largely of a cooperative nature and in a number of cases has been aided by State appropriations. Experiment stations in the irrigated region have been encouraged and assisted in carrying on investigations along this line and the irrigation experts of this Office have cooperated with the local investigators in all possible ways. Drainage was later added to the work of this Office, this work consisting in making surveys and experiments to determine the best methods of draining wet lands. At present the work is largely centralized in Washington, with branch offices in Berkeley, Cal., and Cheyenne, Wyo. The field work is carried on throughout the United States.

IRRIGATION.

Since 1906 the plans for this work have been such that the investigations cover general lines so far as possible, and publications, therefore, take the character of manuals upon certain phases of irrigation practice and conditions in particular localities. Measurements of the quantity of water used by irrigators are being made throughout the irrigated region for the purpose of determining the duty of water with the losses from seepage and evaporation in the canals and the duty of water with all losses except those from evaporation and seepage in the fields eliminated. It is recognized that the great problem in the irrigated West is to increase the duty of water. The quantity of water in streams being fixed, the ultimate acreage

which can be reclaimed depends on the use of more skillful methods of handling water and the practice of greater economy in actual irrigation and in the distribution of water by means of canals.

Fundamental to the formulation of rules for practice in this regard is the determination of the exact amount of water used and required by plants in the processes of growth and the determination of the limit of profitable economy in the use of water in ordinary field practice. At present these determinations are being made chiefly in California and Utah. It has been found that in many cases, however, much of the water turned into canals is lost in transportation. Numerous tests are therefore being made in devising means of lining canals so as to prevent this loss by seepage. The loss of water from canals by evaporation is not so serious a matter, but evaporation after the water has been applied to the land goes on rapidly. Experiments have therefore been made to determine methods of application by which the evaporation could be reduced to a minimum. In some of these tests the saving of water has been equal to from 10 to 20 per cent of the quantity applied. The principles worked out in these experiments may readily be used in practical irrigation.

A considerable part of the irrigation funds of the Office have been devoted to irrigation extension work, in which it is sought to give demonstrations of proper irrigation practice for settlers in the irrigated region. The irrigation agents of the Office, wherever possible, give personal advice on methods of irrigation to new settlers.

In the arid, semiarid, and humid regions a considerable part of the water used for irrigation must be pumped from wells. A large number of tests have been made to

determine the efficiency and relative value of pumps and engines of various sorts to be used for pumping irrigation water. In connection with this work a series of tests have been carried on to determine the power value of denatured alcohol as compared with other sources of power for farm engines.

Since the beginning of the irrigation work of the Office much attention has been given to a study of the effects of irrigation laws, public administrative systems, and ditch regulations upon the economical use of water. The publications on this subject have called attention to the evils in some existing laws, the lack of harmony between laws and public interest, and have pointed out lines along which new legislation should be cast.

In recent years there has been a large awakening to the possibilities of irrigation in the humid climates. The Office has carried on investigations along this line, particularly in the irrigation of rice, cranberries, potatoes, strawberries, and other garden crops. The results obtained have shown that the productiveness of the soil may be greatly increased even in humid States by having arrangements for the application of water during seasons of drought. All of the irrigation work carried on by the Office has for its ultimate object a determination of suitable methods for the largest possible use of the natural water supply.

DRAINAGE.

The problems of drainage are intimately connected with those of irrigation and in 1903 the irrigation work of the Office was made to include investigations in drainage. The drainage work of the Office includes studies upon the reclamation of lands in the arid region which have

been injured by seepage from canals or by the accumulation of alkali and of swamp lands in the humid region which are naturally too wet for agricultural use, either from lack of drainage or from overflow and flooding.

The drainage investigations coming within the scope of the Office include the determination of methods by which land may be drained; the preparation of plans for and the supervision of experimental work where drainage has been previously attempted; the installation of experimental drains in cooperation with States, counties, or individuals; making drainage surveys and estimates for comprehensive systems; assisting drainage engineers with surveys, plans, and reports for drainage; examining swamps and overflowed lands, and ascertaining current processes in various parts of the country.

The drainage of irrigated farm lands has been studied in Washington, Utah, Wyoming, and California. Special surveys and plans have been made for the drainage of an area of 3,000 square miles in the Red River Valley of North Dakota. Surveys and estimates have also been made for the improvement of Boggy Bayou, in Arkansas, which will materially benefit 50,000 acres of lowland along the Mississippi. The Office has also made a survey to determine the feasibility and cost of improvement of Black Bayou, in Mississippi, which will provide ample outlet drainage for 50,000 acres of fertile land.

The tidal rivers of South Carolina have been the subject of an investigation and report with reference to determining the cost of more complete protection of these lands from tide water and their drainage for use in the cultivation of dry land crops instead of rice. Surveys have also been carried on in Charleston County, S. C., to form the

basis of estimates for the drainage of a large tract of fertile land which is at present too wet and unhealthful.

Recently the Office has undertaken a preliminary survey of the Everglades, in Florida, for the purpose of determining the engineering features and the difficulties which will have to be met in a possible attempt to drain this area. The preliminary line of levels has been run across the region.

The agents of the Office are frequently called in consultation by engineers and drainage boards having charge of large drainage projects in various parts of the country.

O

PORTO RICO EXPERIMENT STATION.

D. W. May, M. Agr., Special agent in charge, Mayaguez.
W. V. Tower, B. S., Entomologist and plant pathologist.
M. J. Iorns, Horticulturist.
J. W. Van Leenhoff, Coffee expert.
E. F. Curt, Farm superintendent.

NUTRITION INVESTIGATIONS.

C. F. Langworthy, Ph. D., Chief of nutrition investigations.
R. D. Milner, Ph. B., Editorial assistant.
C. D. Woods, B. S., Special agent at Orono, Me.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

Elwood Mead, C. E., D. E., Chief of irrigation and drainage investigations.
C. G. Elliott, C. E., Engineer in charge of drainage investigations.
R. P. Teele, M. A., Expert in irrigation institutions.
F. W. Roeding, Expert in irrigation extension.
Samuel Fortier, M. E., Engineer in charge of Pacific district.
Irrigation engineers.—S. M. Woodward, A. P. Stover, C. E. Tait, B. P. Fleming, S. O. Jayne, Elias Nelson, P. E. Fuller, W. O. Bryant, R. G. Hemphill.
Drainage engineers.—J. O. Wright, J. T. Stewart, C. F. Brown, Lawrence Brett, L. L. Hidinger, H. A. Kipp, D. G. Miller, Omar Fairley, V. M. Cone, E. W. Chadwick.